

## UNDESCENDED TESTICLE.

BASED ON A STUDY OF SEVENTY-SEVEN CASES.<sup>1</sup>

BY WALTER B. ODIORNE, M.D.,

AND

CHANNING C. SIMMONS, M.D.,

OF BOSTON.

THE deformity resulting from a partial or faulty descent of the testicle has been recognized for centuries, and has been commented on by many of the earlier writers; yet not until the last half-century has the condition been given the prominence which it merits on account of its comparative frequency and importance from a surgical stand-point. The literature abounds in reports of single cases, and articles dealing with special branches of the subject; yet there is a notable lack of valuable statistics drawn from the careful study of a large series of cases. There exists a wide variance in the opinion of surgeons as to the proper method of treatment, and of pathologists as to the significance of the condition. It is interesting to note that mention of cases of abnormal position of the testicle was made in the works of Paré, Meibomius, and Salmuth, and, antedating these, from the fourteenth century we get the supposedly authentic information that Tamerlane, the conqueror of Western Asia, was himself afflicted with this deformity.

John Hunter,<sup>1</sup> in his earliest published work, first gave the subject prominence by describing the normal descent of the testicle in the fœtus, and mentioning abnormalities in this descent. The first surgical operation to correct the position of an undescended testicle was performed by Koch, of Munich, in 1820. Lecompte<sup>2</sup> in 1851 mentioned the frequency of

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<sup>1</sup> Seventy-four of these cases were treated at the Massachusetts General Hospital, and are included in this report through the courtesy of the Visiting Staff.

malignant disease, and most writers in the first half of the last century dwelt exclusively on this point. (Arnott,<sup>8</sup> 1848; Gowers,<sup>4</sup> 1849; Spry,<sup>5</sup> 1857; Johnson,<sup>6</sup> 1859.) Godard<sup>7</sup> in 1857 wrote the first exhaustive article on the subject. Curling,<sup>8</sup> in 1866, in his work on "Diseases of the Testis," dwelt especially on this condition. Since then no elaborate work covering the entire subject has appeared until the publication of the Hunterian Lectures on "The Imperfectly Descended Testicle," by W. McAdam Eccles.<sup>9</sup>

There should be a distinction drawn between the terms undescended testicle, by which is meant one which has been arrested at some point in its normal course of descent, and imperfectly descended testicle, as used by Eccles, and which includes the above class as well as the various forms of ectopia.

The term ectopia of the testicle is used to designate a malposition of an organ which in its descent has deviated from the normal course. There are three forms of ectopia: (1) That in which the testicle occupies a position in some part of the perineum. (2) In which the testicle is situated in Scarpa's triangle, often referred to as the crural form. (3) In which it is placed near the root of the penis, or subcutaneously above the inguinal canal.

These positions correspond to the attachments of certain fibres of the gubernaculum testis, which fibres undoubtedly are instrumental in bringing about the malposition. Tuffier<sup>10</sup> reports that in a dissection of three cases the attachment of the gubernaculum was never found in the scrotum. In one of his cases, a distinct band of gubernaculum was found traversing the perineum to its attachment near the anus.

The term monorchidism is often erroneously used to designate a condition where it is impossible on superficial examination to locate one testicle. In reality this is a misapplication of the term, which should be restricted to entire absence of one testicle, a condition of doubtful occurrence except in hermaphroditism: the correct nomenclature would be monocryptorchidism. An individual in whom neither testicle can be located is a double cryptorchid.

Curling reports a case of fused testicle consisting of one organ with two epididymes and two cords. Christopherson<sup>11</sup> reports a case where at operation he found both cords passing out through the same canal, and both testes, one rudimentary, on the same side of the scrotum. Polyorchidism is extremely rare. Only one authentic case has been reported (Lane<sup>12</sup>) in which the condition was verified by autopsy and microscopic examination. Many cases thought to be examples of this condition are undoubtedly tumors. In the following consideration of the subject, attention is paid only to the undescended or partially descended testicle.

*Occurrence.*—It is very difficult to compute with accuracy the percentage of individuals who have undescended testicles. In the first place, hospital statistics are misleading, for patients seeking treatment with this condition usually present themselves for some complication such as hernia, inflammation, etc., rather than for the relief of the deformity itself.

The most accurate statistics obtainable in adults were made by Marshall, quoted in Koehler's "Surgery," who in the examination of 10,800 recruits found twelve cases,—one double, five right, and six left,—that is, 1 to 900. This, even, is inaccurate, for men, recognizing the fact that they were imperfect in this respect, might not apply for the army.

As the testicle, undescended at birth, very frequently completes its descent during childhood, the percentage of occurrence varies in inverse ratio to the age of the individual up to puberty. Various authorities place the limit of age, after which descent is unlikely to take place, from the first to the fourteenth year. Curling states, however, that, if the testicle is not descended at one year, it is very unlikely to come down, but the statistics of other observers and the following cases would tend to refute the statement.

CASE 3.—Aged fourteen years. Right undescended testicle with hernia. Left testicle descended at five years.

CASE 30.—At age of thirteen right testicle could not be felt. One year later it was found subcutaneously above the external ring.

A case, not in the table, brother of Case 74, had both testes in canal up to age of thirteen, when they descended, massage having been used.

Sach,<sup>13</sup> in an examination of 143 male infants, from one to four months old, found 14 per cent. of cryptorchids, twelve cases being double cryptorchids. Wrisburg, quoted by Curling, examined 103 male infants at birth, and found that 30 per cent. of them had one or both testicles partially descended. In twelve cases, one or both testicles were still retained within the abdomen; but three weeks later he examined ten of these twelve, and found in every case the organ in normal position.

*Gubernaculum*.—As the gubernaculum undoubtedly plays an important part in the descent of the testicle, a brief description of its development and association with the testicle is in order.

It is derived from a fold of peritoneum covering the Wolffian body, and extends in early embryonic life from the lower part of the primitive kidney to the inguinal region. The testicle is developed from the genital fold, lying between the Wolffian body and the median line. As it develops, the Wolffian body shrinks; part of it, however, forming the epididymis and the vas deferens. The gubernaculum transfers its upper attachment to the lower portion of the testicle. It is composed at this time of a fold of peritoneum surrounding fibrous connective tissue. Later, smooth and striped muscular fibres appear, probably derived from the abdominal muscles. As the lumbar spine grows, the gubernaculum holds the testicle in a fixed position, so that at the end of the sixth month it lies close to the internal abdominal ring. Now the gubernaculum extends through the inguinal canal and has its main attachment at the base of the scrotum. Fibres, however, find attachment in Scarpa's triangle, the perineum, and at the root of the penis.

It is a much disputed point whether the gubernaculum assists in the descent of the testicle by muscular contraction, cicatricial contraction, or whether its rôle is simply a passive one. At the sixth month, with the descent of the gubernaculum

into and below the inguinal canal, a finger-like process of peritoneum—the processus vaginalis—accompanies it and passes into the scrotum, where the lower portion later forms the tunica vaginalis, the upper portion being obliterated.

*Cause.*—The precise cause of arrest of the testicle in its normal descent is hard to determine, but is invariably due to some defect in development during embryonic or foetal life. In general, abnormalities of the mesorchium, gubernaculum, inguinal canal, or of the testicle itself, together with the epididymis, ducts, and vessels, are assignable as causes in most cases.

As a result of foetal peritonitis, adhesions may persist which prevent the testicle from entering the internal ring; while in infancy and childhood the pressure of a truss used to withhold an inguinal hernia may also produce the same effect.

Several of the older authorities mentioned heredity as a prominent etiological factor in this condition. Godard believed in its importance, and cited two cases, but of late the tendency has been to treat the matter as of little consequence.

CASE 18.—Man, present age twenty-nine, with right undescended testicle; has a son two years old, with neither testicle descended.

CASE 74.—Man, twenty years old, a double cryptorchid. His younger brother had both testicles descend to scrotum at age of thirteen.

*Varieties.*—An undescended testicle may be classified according to the position which it occupies. Such classification is in many cases inaccurate, for the organ frequently changes its position.

A testicle may lie (1) entirely within the abdominal cavity, a condition known as abdominal or iliac retention; (2) in the inguinal canal, inguinal retention; (3) just outside the external ring, in close relation to the pubic bone, pubic retention; or (4) in the extreme upper part of the scrotum, pubo-scrotal retention. Occasionally, with the testicle itself lying entirely within the abdomen, its epididymis is found to occupy the inguinal canal; and in some cases of inguinal retention the

epididymis has descended to the scrotum. But it is easy to understand how one variety may readily pass into another; for example, an inguinal testicle can often be pushed into the abdominal cavity, while one occupying the pubic position frequently enters the canal as a result of muscular action.

*Side.*—From an examination of the table, it will be seen that the right side is more often affected than the left, for, out of seventy-seven cases, fifteen were double cryptorchids, and in the remaining sixty-two cases thirty-nine were right and twenty-three were left.

Eccles has stated that the right testicle was very much more often arrested than the left, which is in accord with the statistics of most writers. This is to be expected, in view of the fact that the left testicle is normally placed lower than the right, due perhaps to a greater length of the spermatic cord.

*Position.*—It is well known that the inguinal variety is by far the most common, and the statistics based on the series of cases are in accord with this fact.

Abdominal retention, 17; inguinal retention, 51; pubic retention, 18; puboserotol retention, 5; subcutaneous, above external ring, 1 (ectopia).

As will be shown later, the inguinal variety is most prone to the various complications and inflammations, and would therefore be more often seen by the surgeon.

In all cases of undescended testicle there is a certain amount of atrophy of the corresponding side of the scrotum. The degree of atrophy varies very markedly. Disregarding the cases of infants and very young children, in whom the precise size of the scrotum is hard to determine, it may be said that the degree of atrophy has some definite relation to the position of the testicle on that side. In high arrest, that is, in abdominal or high inguinal cases, the scrotum in late youth and adult life is usually found to be very much atrophied; while if the testicle is placed just outside the external ring, perhaps occasionally entering the canal, the amount of atrophy of the scrotum is less marked.

*Symptoms.*—Many men go through life with a single

undescended testicle without symptoms of any kind referable to that defect. In fact, it is probable that the great majority of undescended testicles, especially such as are retained in the abdomen, or have reached a high position in the scrotum, give rise to no trouble whatever except such as would be caused by the knowledge of such imperfect development. French writers dwell on the prevalence of sexual neurasthenia among these men, giving it as a common cause for nervous debility or anxiety; but in this country, as far as can be ascertained, this symptom is not prominent.

The undescended testicle is more commonly the seat of inflammatory conditions than one which is normally placed, for the scrotum forms an admirable covering for the protection of the testicle. This body, lying suspended and loose in the cavity of the scrotum and surrounded by a serous membrane, is capable of great mobility, and can therefore easily slip about within the scrotum, and thus avoid injuries from blows and squeezes (Gray). The testicle retained within the abdomen is free from trauma, and, as Eccles has stated, is as little liable to attacks of traumatic inflammation as is the normally placed ovary.

The same cannot be said, however, of a testicle which is retained within the inguinal canal, or is situated in the pubic region. Such an organ, from its position alone, is very liable to injury. The comparatively fixed position makes it impossible for it to escape the force of blows and the effect of pressure from without, while the sudden and violent contraction of the abdominal muscles, by pressure on the testicle in the canal, is often a cause of most painful and severe inflammation. This may vary in degree from slight sensations of discomfort after severe muscular exertion or straining, up to frequent attacks of very severe pain, accompanied by swelling, extreme tenderness, nausea, and vomiting. These attacks may recur with such frequency as to completely incapacitate the individual for his work.

The following case illustrates the milder type of inflammation.

CASE 71.—A single man of twenty-four years, with left testicle retained in canal, where since puberty it had formed a small, tender tumor. For ten years had been subject to attacks of moderately severe pain on exertion, a source of great discomfort and annoyance. He said that the testicle was "much in the way, for it was continually getting hit." At operation it was found greatly atrophied and was removed.

The following gives a picture of a much severer type of inflammation, occurring in an uncomplicated case.

CASE 31.—A man, aged nineteen years, had a right partially descended testicle, situated in the pubic region, just outside the external ring. At the age of fifteen, he had a severe attack of pain in right testicle, accompanied by nausea, vomiting, and prostration. During the attack there was a tender tumor, size of fist, in right groin. Since then has had similar attacks three or four times a year, which have interfered greatly with his work. At operation, the testicle was found just outside the ring, considerably atrophied, but freely movable. It was sutured into the serotum.

Inflammation of an undescended testicle sometimes occurs when the organ is forced into a different position; for example, where an abdominal testicle is made to enter the canal under pressure, or where one which has been retained in the canal is forced out of the ring on to the pubis. Under such conditions, orchitis is apt to occur, and persist until the organ is returned to its former position. A properly applied truss often relieves a patient who is subject to attacks of inflammation due to the above cause, for it prevents the testicle from assuming, under force or pressure, a new position.

The following report illustrates such a case.

CASE 18.—A man, twenty years of age, had his right testicle retained within the canal, associated with a right inguinal hernia of moderate size. This condition had existed as long as he could remember. The hernia had always been easily reducible, and the testicle had given him no trouble. He entered the hospital in January, 1895, with his hernia strangulated. This was reduced



under ether, but there was left a tender tumor, size of walnut, situated just outside the ring. For five days the testicle remained in this position, and was the seat of acute inflammation, at the end of which time it suddenly slipped into the canal, with almost immediate relief of all symptoms. He was given a truss and left the hospital.

In December, 1903, about nine years later, he reported that he had worn a truss most of the time; there had been no further trouble. Occasionally, when the truss was left off, the testicle emerged from the ring, causing slight pain and a feeling of weakness.

In the seventy-seven individuals recorded in the table, there were ninety-two undescended testicles, for fifteen had double arrest.

In thirty-four, there were no symptoms referable to the testicle. In thirty-two, there had been symptoms previously referable to the testicle. In twenty-six, there had been no symptoms until the time they came under observation.

**PHYSIOLOGY.**—During infancy and childhood, the testicle, whether normally or abnormally situated, probably plays no important part in the general development or bodily economy, but at the approach of the age of puberty, and from that period during the lifetime of the individual, the testicle assumes a new importance, special functions are given it which are retained during the whole or part of adult life, and its influence on the development and maintenance of function of the individual is worthy of consideration. At puberty, then, the testicle becomes associated with two distinct physiological processes, (first) the formation of spermatozoa within its tubules, and (second) an undoubted influence, manifest during early and late adult life, on the general development, growth, and bodily economy.

The impairment of function in the undescended testicle in respect to the first of these processes, that is, the production of spermatozoa, is a matter of considerable practical importance. An undescended testicle is almost invariably imperfectly developed, as regards size, consistency, and minute anatomy; and

it is agreed by all observers that such a testicle is incapable of the formation of spermatozoa, in a great majority of cases. This conclusion is based on the microscopic examination of such organs, as well as of the semen of double cryptorchids. Griffiths<sup>14</sup> has stated that there has never been an authentic case of spermatogenesis in an undescended testicle, but most authorities take a somewhat less positive view. The examination of several undescended organs removed at operation and the clinical history of a case (20) mentioned below show that the process of spermatogenesis is not only possible, but less uncommon than has been generally stated.

Three different views have been held regarding the frequent impairment of function of such testicles.

First. The retained testicle is imperfectly formed from the beginning, and its abnormality is a factor in its non-descent. (Hunter.) Second. The organ, although undescended, is normal until the age of puberty, and it then fails to develop. (Curling.) Third. The testicle, although undescended, becomes a perfect organ at puberty, but then, owing to its faulty position, it soon undergoes retrograde changes, resulting in partial or complete atrophy. (Monod and Arthaud.<sup>15</sup>)

It is a fact that some testicles are imperfect in structure from the beginning, never developing after foetal life or early infancy. Such organs are usually retained within the abdomen, and are always incapable of producing spermatozoa. It is also true that some testicles though undescended are of normal structure during childhood, but undergo none of the changes which are normal at puberty. It is not rare for a testicle which has been retained in its descent, but transplanted in youth to the scrotum by operation, to fail in its development at puberty, although its position then is natural. In other cases there is no doubt but that the malposition of the organ, for one cause or another, is directly responsible in preventing the proper development at puberty, and in the establishment of retrograde changes and atrophy. Griffiths,<sup>14</sup> in experiments performed on dogs, has shown that if normally descended testicles be

returned to the abdomen they become soft and small, and never show active spermatogenesis.

Still another view, which seems to be true in a certain number of cases, has been supported by Bellingham-Smith,<sup>10</sup> Monod and Arthaud, and others. They have stated that occasionally in undescended testicles the function of spermatogenesis is established for a time, but that it persists for only a brief interval of years, and then is lost. It is an undoubted fact that all double cryptorchids who have been reported to be the fathers of children have been very young men; their children having been born within the first few years after the establishment of puberty in the fathers. It has been stated that the function is never retained after the age of thirty.

The following case, No. 20 in the table, illustrates this point, as well as proving that not all double cryptorchids are sterile.

J. A. P. entered the hospital in July, 1895, at the age of fourteen. Since birth had noticed a small lump in each groin and absence of testicles in scrotum. The testicles, which were in the canals, occasionally descended to a high position in the scrotum, causing pain, which could be relieved by pushing them back inside the rings. Of late had had more frequent attacks, with greater difficulty in replacing organs. Examination showed considerable atrophy of the scrotum, and the testicles situated within the inguinal canals. An attempt was made at operation to bring the testicle outside the ring, but this was impossible, owing to shortness of the cord. The testicle was, therefore, pushed back into the abdominal cavity, and the canal closed, as in a Bassini operation. No operation was done on the right side.

At age of twenty patient was married, and became the father of a boy ten months later. Examination of patient, January 19, 1904, nine years after the first observation, showed complete atrophy of scrotum. The left testicle could be vaguely felt within the canal. It was soft and very small. On the right the testicle was very small, about one-eighth normal size, soft, and situated just outside external ring. The patient stated that he was leading an active sexual life, and considered himself normal in that respect. His wife had not been pregnant since the birth of the first child, four years before.

The above-mentioned individual, a double cryptorchid with very marked atrophy of both testicles, was unquestionably fertile at the age of twenty, but the subsequent history of his case suggests that the spermatogenetic function was not long retained. The following case, a man of the same age, also with double inguinal retention, but with very slight atrophy, was apparently sterile.

CASE 74.—Aged twenty years. Had always been aware of absence of testicles from scrotum, but had suffered no inconvenience until last two years. Of late, after prolonged standing or unusual exertion, had noticed painful lumps in both groins. Was wearing truss for relief of these symptoms. Examination showed both testicles to be situated in the canals, and fairly well developed, the right being slightly smaller than the left. Scrotum was atrophied. A careful microscopic examination of the semen failed to show the presence of spermatozoa.

Thus it can be seen that no rule can be applied to the spermatogenetic function of undescended testicles. In general, it may be stated that this function is absent in a majority of cases, but the proportion of those in which the organ is capable of the formation of spermatozoa is undoubtedly greater than has been supposed.

An individual with one testicle normally developed and situated in the scrotum is in no way affected as to bodily development and the power of procreation, although the other testicle may have been arrested in its descent. It is perhaps worthy of note that the normally placed organ shows no evidence of compensatory hypertrophy.

PATHOLOGY.—The histological appearances of undescended testicles vary within wide limits, and it is impossible to give any anatomical classification. In some cases there is very little, if any, change in the gross appearance of the organ, and even microscopically at first glance the section may appear normal, although on careful examination marked deviation from the properly descended adult organ can be found. In

other cases the testicle is at once recognized as being diseased and pathological. This variability is not constant with the position of the organ or the age of the patient, an inguinal testicle being sometimes more developed than one in the external ring, or an abdominal more than an inguinal. Two testicles from the same position in patients of the same age also may vary, and some parts of the organ may show marked change, while others, often closely adjacent parts, may be comparatively normal.

The changes occur in the albuginea, interstitial tissue, epithelium, and the basement membrane of the tubules, one or all of which structures may be involved.

The changes have been divided by Branca and Felizet<sup>17</sup> into two distinct groups,—those occurring before puberty and those taking place during adult life. In most cases there is probably little or no change till puberty, unless there has been some trauma; and it must always be borne in mind that no rule can be applied for the amount of this deviation from the normal. (Bezançon.<sup>18</sup>) In this series of cases unfortunately no specimens were removed before puberty, and the following brief description is based mainly on the findings of Branca and Felizet.

In children the change is essentially a fibrous one, and, in marked cases, is represented by the small atrophic testicle sometimes seen in later life, where the organ closely resembles a fibroma, no structures of the normal testicle being demonstrable even with the microscope. The albuginea in the less extreme cases is thickened, and usually two layers can be distinguished. The basement membrane of the tubules is thin, and in many cases cannot be distinguished from the surrounding tissue, the reverse of which is true in the changes occurring in later life. The peritubular connective tissue is increased, making on section the lobules very prominent, and composed of cells of the embryonic variety, but approaching the adult type near the body of Highmore. Interstitial cells are rare instead of being present in comparatively large numbers, as is the case in the normal testicle before puberty. The epithelial

cells lining the tubules are usually of a uniform type, although in some specimens a slight differentiation can be distinguished. The vas and epididymis are, as a rule, normal.

*In the Adult.*—A testicle occupying a position in the base of the scrotum, or even in the groin, may vary in gross very little from one normally placed, but is usually flaccid and small. The epididymis may show some slight malformation, and is often separated from the testicle by a greatly lengthened mesorchium. The seminal vesicle on the affected side may be atrophied. (Launois.<sup>10</sup>) The vas is also usually normal, although tortuous, but will, when dissected out, allow the organ to assume its normal position. On section the tunica albuginea may be thickened, and the cut surface does not bulge in the manner characteristic of the normal gland, although the tubules may "string out" well. In the more fibrous specimens the increase of interlobular connective tissue is very marked.

*Microscopically.*—The tunica albuginea was more or less thickened in all of the specimens examined, in two being roughly five times as thick as that of the normal organ. The interlobular connective tissue varied greatly in amount, but was in all but one specimen (Case 77, Plate IV, Fig. 2) increased. In three cases (Cases 71, 72, 73, Plate IV, Fig. 1) the organ was composed in greater part of fibrous tissue, while in the remaining five (Cases 1, 44, 47, 52, 70, Plate IV, Fig. 3) the increase, although marked, was not as extreme. Plate III, Fig. 1, gives a good idea of the relative proportions of the tubular and fibrous tissue in a moderate case. The increase of the fibrous tissue was in two cases mainly interlobular, but in the others the lobules were not well marked and the intertubular tissues mainly affected. In Case 77 the proportion of the fibrous tissue to the tubules was approximately the same as in a normal organ, and with a low magnification it could not be distinguished from one. The fibrous tissue in all specimens was of the ordinary type, loose in the greater part of the organ, but becoming more dense near the body of Highmore.

*Interstitial Cells.*—One of the most striking features of undescended testicles is the so-called interstitial cell which

occur in all cases, and in some of the specimens examined were present in very large numbers. These cells are normally seen in small numbers in the testicles of children, but disappear about puberty, and are not found in the adult organ. In undescended testicle the reverse is true. Hansemann<sup>20</sup> reports that in the examination of many undescended testicles removed in childhood he rarely found them, while they were invariably present in specimens from the adult. As in this series of cases there were no specimens removed before puberty, it was impossible to verify the first part of this statement, but in all the sections the cells were present. What the function of these cells is in the economy is unknown. It has been suggested that they play an important part in the so-called internal secretion of the gland when active spermatogenesis does not take place. Although this is only theory, yet it is a well-known fact that patients with double retention and non-functionating organs have all the characteristics and desires of the male, which is not true if castration is performed. These cells occur in columns of varying size in the interstitial fibrous tissue between the tubules. According to Monod and Arthaud, they were more frequently seen around the blood-vessels, but in the specimens examined they had no definite relation to any structure of the organ, and were seen in all parts. In places they were in short, single columns, while in others they were in large masses, surrounding four or more widely separated tubules and completely filling the microscopic field. They are endothelial in type and of large size, with well-marked outlines. The nuclei are rounded, usually presenting well-marked nucleoli.

Two types can be distinguished, one with clear protoplasm, while in the other the protoplasm is finely granular, giving the cell a dark appearance and making a marked contrast between it and the surrounding loose, fibrous tissue. Still others contain pigment granules, and occasionally rod-shaped crystals.

*Tubules.*—Another marked deviation from the normal is seen in the basement membrane of the tubules, though it is not as striking a feature in most as are the interstitial cells. This

membrane was thickened in all cases, in some slightly, while in others the lumen was entirely obliterated and the tubule was only represented by a mass of dense, fibrous, and hyaline tissue. Two layers of the membrana propria could be distinguished: an outer fibrous one associated with the intertubular tissue, but distinct from it, which was thin and contained a few well-formed oval nuclei; and an inner hyaline layer. This inner layer was most characteristic and varied greatly in thickness, in many tubules completely obliterating the lumen, while in some specimens in a closely adjacent tubule the membrane was thin and active spermatogenesis was taking place. All grades between the two extremes could be found often in the same specimen and even in the same section (Plate II, Fig. 3). This inner layer consisted of an irregular hyaline-like membrane, often thrown into folds, usually showing no nuclei, although occasionally large, ill-defined, degenerated nuclei could be seen having well-marked nucleoli. This same thickening and hyaline change in the basement membrane can be seen in a much less degree in a senile testicle, and also may be caused experimentally in animals as a result of toxic irritation, but never in experimental stenosis of the vas. (Griffiths.<sup>21</sup>)

*Epithelium.*—The epithelium lining the tubules showed in all cases examined a marked deviation from the normal. In those tubules where a thickened basement membrane had nearly obliterated the lumen there were no cells, or only a few degenerated ones of irregular shape and having indefinite outlines. In the less extreme cases the tubules were lined with a single, rarely double, layer of similar cells of rather large size, showing no mitoses. The protoplasm was granular in most, and in many showed vacuoles. The nuclei were oval and placed near the base of the cell. These cells probably represent the supporting cells of the testicle or cells of Sartoli. In the normal testicle before puberty the tubules are lined with epithelial cells of a single type. At puberty, however, these become differentiated into the supporting cells and the spermatogenic cells. In the undescended organ in most of the tubules this differentiation does not take place, and the greater



number of cells remain as those of Sartoli, although some tubules often in close proximity to these or even to a completely obliterated one show some spermatogenetic cells. Spermatogonia and spermatocytes can be distinguished in many cases, but the process rarely goes on to completion; and it is in only a few tubules that perfectly formed spermatozoa can be found. In the examination of these nine specimens adult spermatozoa were found in four cases (Cases 44, 47, 52, 70), Case 70 being thirty years of age. One case (Case 71) showed on careful search a few tubules containing spermatogonia, while in the other four (Cases 1, 72, 73, 77) no differentiation could be made out, the epithelial cells being absent altogether or present as Sartoli cells.

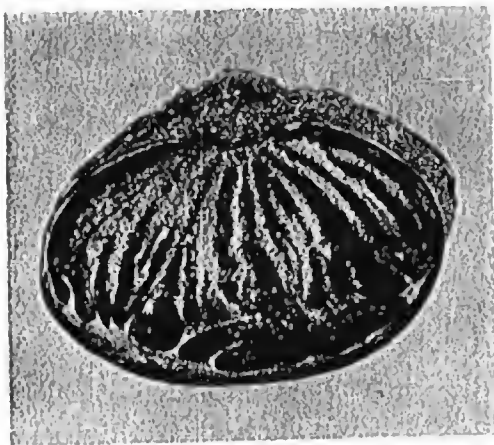
Various forms of crystals are sometimes seen, the most discussed of which are the Reinke crystals described by Reinke<sup>22</sup> in 1896. These are fine needle-like crystals seen scattered through the interstitial fibrous tissue in almost every case, and their function has been variously interpreted. According to their discoverer, they play an important part in the formation of the testicle, while the majority regard them either as foetal remains or products of degeneration.

The following is a brief description of the four specimens from which the plates have been made, illustrating the various types of testicles.

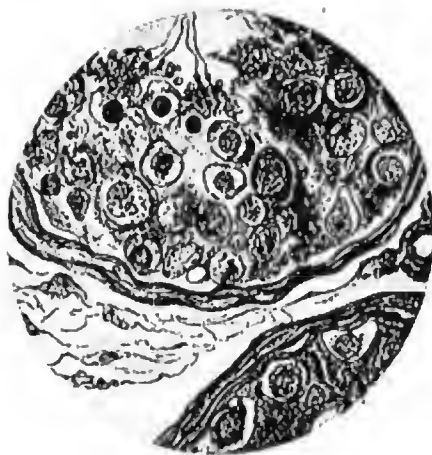
CASE 47.—Aged sixteen years. High inguinal testicle. Plate I, Fig. 1. The testicle was two and one-half by two centimetres in diameter, and of normal shape, but of soft consistency. The vas and epididymis were normal and the mesorchium not marked. On section the albuginea was thickened, the lobules were well marked, and there was an increase of the fibrous tissue.

Microscopic examination showed the albuginea thickened and composed roughly of two layers, an outer one of dense fibrous tissue, and an inner one composed of loose tissue which merged into the interlobular fibrous tissue, and contained numerous small vessels. The interlobular fibrous tissue was increased, and contained many small oval nuclei, a few vessels, and some

# PLATE I



1.



2.

FIG. 1.—Longitudinal section of the testicle from Case 47 magnified three diameters. This gives a very good idea of the relative proportion of the filiform and tubular tissue in the average case, and also shows the thickening of the albuginea.

FIG. 2.—Normal testicle showing active spermatogenesis. The cells are seen in all stages from the spermatogonium to the adult spermatozoa. The supporting cells are best seen in the portion of the tubule at the lower part of the field. Zeiss Comp. Oc. 4. Objective, 2 millimetres. Oil immersion.

## PLATE II.



FIG. 1.—Section from Case 73. This shows the more advanced type. The tubules are for the most part represented by masses of hyaline tissue, and where the lumen is present it is filled by detritus and an occasional epithelial cell. The tubules are of irregular shape and widely separated by loose fibrous tissue containing large areas of interstitial cells. Zeiss Comp. Oc. 4. Objective, 8 millimetres.

FIG. 2.—Section from testicle of Case 77. There is no increase in the fibrous tissue, which, however, contains many small areas of interstitial cells. The basement membrane of the tubules is only slightly thickened, but they contain only supporting cells, no spermatogenic cells being seen in any section. Zeiss Comp. Oc. 4. Objective, 4 millimetres.

FIG. 3.—Section from testicle of Case 70. The tubule in the upper part of the field shows some thickening of the basement membrane, but in the lower portion of it active spermatogenesis is taking place, although in the upper part none but supporting cells are seen. The tubule in the lower part of the field is nearly obliterated by the thickening of the basement membrane. The fibrous tissue is increased and contains many interstitial cells. Zeiss Comp. Oc. 4. Objective, 4 millimetres.

Reinke's crystals. Some of the lobules were more nearly normal than others, the least change being seen near the capsule. As a rule, the tubules were separated by a considerably increased amount of connective tissue containing many large areas of interstitial cells. The basement membrane of the tubules was thickened, and in most two layers could be distinguished, but in many the change was not marked. In some of the tubules there was no evidence of spermatogenesis; but, although Sartoli cells predominated, spermatocytes, spermatids, and in several fully developed spermatozoa were seen.

CASE 70.—Aged thirty years. Position inguinal. Plate II, Fig. 3. The testicle was three by one and one-half centimetres in diameter, soft, and had connected to it by a long mesorchium the epididymis and six centimetres of the vas. Portions of the parietal tunica were closely adherent to it in many places. On section the albuginea was thickened, and, although the lobules were not well marked, the tubules "string out" well.

*Microscopic examination* showed the tubules widely separated by loose fibrous tissue, in which were masses of interstitial cells and Reinke's crystals. The tubules themselves showed a much thickened basement membrane, which was usually divided into a thin outer fibrous zone, and an inner one, thicker, of hyaline tissue containing no nuclei. The amount of this thickening varied greatly, being scarcely noticeable in some tubules, while in others it obliterated the lumen. Where the membrane was markedly thickened, the tubules were lined with a single very irregular layer of cells with oval nuclei and granular protoplasm, often containing vacuoles. In other places were tubules, which, although showing a somewhat thickened membrana propria, showed active spermatogenesis and contained adult spermatozoa. These normal tubules were seen singly and in groups, often being in close apposition to others showing complete obliteration.

CASE 73.—Aged twenty-nine years. Position pubic. Plate II, Fig. 1. The testicle was soft, two by one centimetre in diameter, and fastened to the wall of a hernial sac. It was separated from the epididymis, from which a tortuous vas eight centimetres long led off, by a long mesorchium. On section the albuginea was thickened and the organ noticeably fibrous.

*Microscopic examination* showed the albuginea much thickened. The greater part of the organ was composed of rather

dense fibrous tissue, with many small oval nuclei, and containing large numbers of Reinke's crystals. There were also many interstitial cells, some in groups of three or four, others larger, occupying all of the field under high power. The tubules were scattered irregularly throughout the sections and had no definite arrangement. They presented a thick basement membrane in two layers, the outer being thin and fibrous, the inner thick, in many cases obliterating the lumen and giving the tubules the appearance of a solid hyaline mass. In some this process was not so advanced, and a few degenerated epithelial cells having no structure could be seen lining the tubules.

CASE 77.—Aged twenty-three years. Inguinal testicle. Plate II, Fig. 2; Plate III, Figs. 2 and 3. The testicle was three by one and one-half centimetres in diameter and connected to the epididymis, which was imperfectly formed by a lengthened mesorchium. The cord was five centimetres long and not tortuous. On section the tunica was thickened, but otherwise the organ appeared normal.

*Microscopic examination* showed no marked increase in the interstitial tissue, and the tubules, closely packed together and of normal size, giving the section the appearance, under the low power, of a normal organ. Under high power, the basement membrane was slightly thickened, and in the small amount of interstitial tissue were a few interstitial cells. The most marked change was in the tubular epithelium. This was represented by irregularly placed rounded or oval nuclei lying in faintly-staining granular protoplasm often containing vacuoles. In no tubule was there any evidence of spermatogenesis, and all appeared to be in about the same stage of development.

*Complications.*—The inflammatory conditions to which the undescended testicle is especially liable have been discussed under symptomatology. There are other forms of acute and chronic inflammations, due either to extension of morbid processes from the urethra, or to constitutional disease. Attacks of simple inflammation, if oft repeated, frequently result in marked atrophy of the testicular substance, the organ becoming a mass of fibrous tissue. An arrested testicle, even if atrophied, is liable to gonorrhœal infection from the urethra.

PLATE III.



1.



2.



3.

FIG. 1.—Photograph of testicles from Case 1 removed at autopsy, showing the difference in size of the normal and undescended organ. The lengthened mesorchium and tortuous cord can also be seen.

FIGS. 2 and 3.—Photographs of the testicle from Case 77. At the upper part of the specimen the remains of the hernial sac is seen. The cord is tortuous and the mesorchium somewhat lengthened.

CASE 52.—Twenty years of age. Left inguinal retention. Two days before entrance to hospital, during an attack of gonorrhœa, first noticed pain in left groin, with tender lump. No vomiting. At operation, a small atrophied testicle, acutely inflamed, and surrounded by considerable porky inflammatory tissue, was removed from the canal.

Pathological examination (abstract of report of Dr. J. H. Wright). On section the epididymis was dark red in color, and showed many grayish tubules filled with purulent material. Smears of this stained by Gram's method showed intra- and extracellular Gram-decolorizing diplococci. Cultures on hydrocele agar showed pearly-white colonies, the largest two millimetres in diameter in forty-eight hours, of Gram-decolorizing diplococci. Cultures on plain agar showed no growth. Microscopic examination showed the larger tubules filled with pus, while the smaller ones were comparatively normal. In some tubules the epithelium was absent, and there were purulent infiltration and disintegration of the surrounding tissues. In many of the cells diplococci like gonococci were present. The interstitial tissue showed marked infiltration with fibrin and leucocytes and other inflammatory cells. The vessels were dilated. The vas showed loss of epithelium and contained pus-cells. There was some infiltration of the cord with inflammatory exudate.

Parotitis has been mentioned as a cause of acute inflammation in undescended testicles. In this series, Case 20 was observed during an attack of mumps, which appeared one week after operation on the testicle, but there was no sympathetic inflammation of either organ. Chronic inflammatory conditions are seen when the testicle is the seat of tubercular or, more rarely, syphilitic infection.

CASE 6.—Aged twenty-two years. 1888. Right inguinal retention. One year ago had gonorrhœa and acute epididymitis, followed by swelling in right groin, from which a discharging sinus resulted. At operation, a considerably enlarged testicle was removed from right inguinal canal. Pathological examination showed the testicle and epididymis to be considerably enlarged. On section, in the globus minor were many large pus cavities and necrotic areas separated by fibrous tissue. There were also several small necrotic areas in the testicular substance.

**HERNIA.**—Inguinal hernia is by far the commonest complication of undescended testicle. The symptoms which it produces are very apt to be the cause of a patient's seeking treatment when, perhaps, his attention is called for the first time to the misplaced organ.

In this series of ninety-two cases, there was some form of hernia in forty-nine, *i.e.*, about 57 per cent. Corner<sup>23</sup> has stated that a hernial sac is to be found in 70 per cent. of the cases. In 49,859 hernias observed at the Hospital for Ruptured and Crippled from 1891-1902, there were 400 cases associated with undescended testicle. The patients ranged in age from four to thirty years. (Coley.<sup>24</sup>) Eccles, in 48,000 cases of hernia in the male, found 854 imperfectly descended organs.

It is easy to see why hernia so frequently accompanies this deformity, for the processus vaginalis is seldom obliterated, and its descent into the scrotum precedes that of the testicle, being independent of it. Thus, a hernial sac is formed. In inguinal retention the mechanical dilatation of the canal, due to the presence of the testicle, is a predisposing factor. Sometimes, however, the processus is normally obliterated, and the testicle is formed in a separate sac from that of the inguinal hernia. In this series, thirty were recorded as simple inguinal hernia, eighteen as congenital. It is probable that a more careful recording of many of the cases would have shown a larger proportion of the congenital variety.

Inguinal hernia is unquestionably more apt to become strangulated when associated with an arrested testicle. It occurred in ten of the forty-nine cases mentioned above. Sometimes the testicle seems to act as a ball-valve, by slipping into the canal, and thus holding the gut fast in the scrotum.

**CASE 65.**—Aged twenty-seven years. Right inguinal retention. Had occasionally felt a small tender mass in groin. Entered hospital with large tumor in groin and scrotum; duration, twenty-four hours; marked constitutional symptoms. At operation the scrotum contained a mass of injected bowel and much clear fluid. An atrophied testicle, situated just inside the ring, in the same



sac, was apparently the main factor in preventing the return of the bowel. Testicle was sutured in scrotum and the gut returned.

Rare cases have been reported of monoeryptorchids who have had hernia on the opposite side, suggesting the possibility of a defect in the museular apparatus in the inguinal region. It seems more reasonable to regard them as mere coincidences. In Case 24, in the table, the hernia on the opposite side did not make its appearance until the patient was forty-two years old, and might easily be accounted for by the nature of his work.

*Interstitial Hernia.*—In this form of inguinal hernia, the sac is forced between the abdominal museles or between the external oblique muscle and its fascia. It is comparatively rare, but in the male is nearly always associated with some form of cryptorchidism. It occurs in cases where the testicle, perhaps undersized and undeveloped, is situated low in the canal or just at the ring. A hernial protrusion, caused by increased pressure in the abdomen, finds there an obstruction to its course through the ring, and its sac is forced out from the canal between the layers of the abdominal wall, where resistance is less. In this way a large hernial sac may be developed. The hernia is most often found between the fascia covering the external oblique and the musele itself or its aponeurosis; but it may be found between any two adjacent layers of the abdominal wall.

CASE 56.—Twelve years of age. Left testicle had never descended. Had noticed lump in left groin for four or five years; disappeared on lying down. Three days before admission to hospital, a tumor appeared in groin which was irreducible. Examination showed a tense, tender mass, size of lemon, above Poupart's ligament. Impulse on coughing. At operation, the hernial sac was found to be above the ring, between the external oblique and its fascia. It contained the testicle in a congenital sac, with inflamed omentum and some fluid.

In rare cases an interstitial sac may be caused by an ectopie testicle, which carries with it the open processus vagi-

nalis. (Moschcowitz.<sup>25</sup>) In the same manner, an ectopic testicle situated in the perineum may cause a hernia there.

*Hydrocele.*—If the funicular process is obliterated, simple hydrocele may occur. Such a condition might easily lead to errors in diagnosis of tumors in the groin. The commonest form is congenital hydrocele, when the open processus allows the exit of fluid from the abdominal cavity, but into which neither bowel nor omentum has protruded.

*Torsion of the Spermatic Cord.*—Gangrene of the testicle due to twisting of its spermatic cord is of rare occurrence, but as statistics show that in about one-half the cases the testicle is undescended, the condition is worthy of brief consideration. In 47 per cent. of the cases collected by Scudder,<sup>26</sup> the testicle was undescended. The precise cause of a rotation of the testicle on its axis is not definitely understood, but in all reported cases some abnormality of the organ has been noted. In foetal life the blood supply comes through a mesenteric fold of peritoneum, the mesorchium, derived from the Wolffian body. The mesentery disappears during the descent of the testicle, and in adult life is represented by that part of the organ uncovered by the tunica vaginalis, where the vessels of the cord enter it.

A persistence of the mesorchium as a true mesentery is one of the causes of non-descent of the testicle, for it hinders the organ from being properly engaged at the internal ring. In most carefully reported cases of torsion, a long mesorchium was found, with a testicle freely movable within its tunica, and its persistence is undoubtedly an etiological factor of importance in torsion. Cabot<sup>27</sup> has reported a case of gangrene due to torsion in which the mesorchium was very short, and tightly wrapped around the twisted cord. Rotation results in shutting off, more or less completely, the blood supply, giving rise to hæmorrhagic infarction and interlobular hæmorrhage with subsequent fibrous change, or to gangrene.

In some instances, acute hæmorrhagic infarction, followed by gangrene, occurs where no twist in the cord has apparently been present. Such cases have been reported by

Volkman (1877) and English, as cited by Seudder, and the following may be classified under this heading.

CASE 33.—Aged twenty-one years; single. Right testicle in inguinal canal. For the last three or four years had occasional attacks of pain in right groin with swelling of the arrested organ. Examination showed in the right groin a tense, semifluctuant tumor, size of hen's egg, painful and tender. Impulse on coughing. At operation, testicle found in canal, much increased in size, of purple color. Behind it was a hernial sac filled with clear fluid. There was no twist in the cord. Orchidectomy. The testicle was large and fibrous; and on section there was noted a considerable amount of hæmorrhage in the interstitial tissue. No evidence of spermatogenesis.

Torsion of the cord occurs in the majority of cases in early adult life, and usually follows some excessive muscular exertion or injury in that region. It is noted that the symptoms have frequently appeared immediately following coitus. The symptoms are of sudden onset, often simulating strangulated hernia, but with less constitutional disturbance. Operative interference is always indicated, and orchidectomy is usually necessary. In the cases collected by Seudder there was no mortality.

CASE 23.—Aged twenty-seven years; single; a double cryptorchid. For many years had worn a truss for left inguinal hernia. Four days before admission to hospital, the hernia had become irreducible. There was much pain and tenderness, with nausea and some constitutional disturbance. The scrotum was atrophied; right testicle could not be felt. In left inguinal region was a hard, tender tumor the size of a lemon. At operation, a gangrenous testicle was found in the canal, lying in a congenital sac, which also contained a piece of gangrenous omentum. There were two complete twists in the cord. The testicle and omentum were removed.

The question of the blood supply of the testicle is one of considerable interest, as it has an important bearing on

the surgical treatment in many cases. Much experimental work has been done. It is often found, in attempting to transplant an undescended testicle to the base of the scrotum, that the cord is too short. In such cases, the vessels are usually of insufficient length to allow of any lengthening of the cord by traction, while the vas is somewhat tortuous and offers no difficulties to a successful orchidopexy.

The question arises as to whether the vessels can be, in such emergency, divided without serious injury to the testicle. This has been occasionally done by surgeons without other damage than marked atrophy of the organ. After division of the vessels, the vas has been found to be long enough to permit of transplantation of the testicle. A certain amount of stretching incurs no risk.

Mifflet,<sup>28</sup> in operations on dogs, arrived at the following conclusions: that obliteration of the spermatic artery was always followed by hæmorrhagic infarction of the testicle, and that obliteration of the veins alone was sufficient to cause a degeneration of the testicular substance. Griffiths,<sup>29</sup> in a later series of similar experiments, concludes that after ligation of the spermatic artery there is an immediate diminution in size of the organ and fatty degeneration; later, in rare cases, a portion of the testicle may resume its function. Ligation of the veins leads to great engorgement, followed by gangrene or atrophy. Ligation of both veins and artery leads in most cases to complete wasting. After any of the three procedures, any of the above results may occur.

Torsion of the cord, therefore, may occur without gangrene of the testicle. In fact, it is fair to suppose that mild attacks of orchitis are frequently due to torsion of the cord, in which the blood supply is not seriously impaired.

*Malignant Disease.*—In a study of the undescended testicle, the question of its liability to become the seat of malignant disease is of great importance.

Thiriar<sup>10</sup> (1887) stated that an arrested testicle was a source of great danger to its possessor, on account of the probability of sarcomatous degeneration. The same opinion

has been held by most authorities on the subject for a century, the early writers being impressed by the frequency of tumor formation. Arnott, in 1848, mentions seven cases; Fischer,<sup>30</sup> in 1864, collected thirty-nine cases, and Scymanowski,<sup>31</sup> Kocher, Spry, Godard, Gowers, Johnson, and von Kahl-den<sup>32</sup> have contributed to its literature. Kronpecher<sup>33</sup> mentioned two cases of sarcoma of both testicles in double cryptorchids, and believed that incomplete descent furnished a strong predisposition. Eccles, on the other hand, from a study of a great number of cases, has recently concluded that no sufficient proof exists for the belief that sarcoma is of more frequent occurrence in imperfectly descended testicles.

In a series of fifty-four cases of malignant disease of the testicle, at the Massachusetts General Hospital, during a period of twenty-six years, six cases were in arrested testicles, *i.e.*, 11 per cent. Schädel, quoted by von Kahl-den, reported that in a large London hospital, in one year, forty-one cases of malignant disease were seen, five of which were in undescended testicles, *i.e.*, 12 per cent.

These figures tend to sustain the opinion of the older authorities; and it seems reasonable to believe that sarcoma is of somewhat more frequent occurrence in the ill-developed and abnormally placed testicle. The cause of such predisposition is not clear. Trauma has been suggested, but, as the disease often occurs in cases of abdominal retention, its effects would not seem to be important. It is extremely rare in children; the average age of the six patients reported in the foregoing table was forty years. It is most often noted in inguinal testicles, but is almost as frequently seen in those which have been retained in the abdomen. In the six cases in this table (one double retention), four were inguinal, three were abdominal.

These tumors may attain enormous size. Johnson reported an autopsy where a tumor of the right testicle occupied most of the abdominal cavity, displacing the viscera. The disease is almost invariably fatal, and death usually occurs within a year after the appearance of symptoms. Five of the

six cases reported died within a year. The remaining case lived three years.

It is said that any form of sarcoma may occur. Hansemann has laid stress on the endothelial type, which, he believed, originated in the interstitial cells. Benenati<sup>34</sup> reported a case of rhabdosarcoma of the testicle.

Metastases occur, as a rule, early in the course of the disease. Metastatic growths in the spinal cord are common.

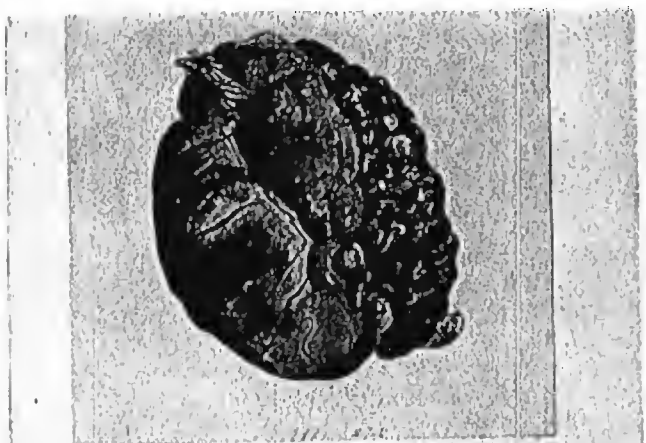
A brief pathological description, based on reports of Dr. W. F. Whitney, of four of the cases in the table is as follows:

CASE 26.—Specimen consisted of an oval growth, thirteen centimetres in diameter, covered with a dense, smooth capsule. On section the tumor was composed of soft, grayish-white tissue, opaque, and divided into lobules by dense bands of fibrous tissue. Many large, soft, necrotic areas and several hæmorrhagic cysts. Microscopic examination showed solid masses of large rounded cells, with round nuclei, and a considerable amount of clear protoplasm. The nests of cells were separated by a comparatively small amount of loose fibrous tissue. Large round-celled sarcoma of endothelial type.

CASE 28.—Plate IV, Fig. 1. An oval tumor, fifteen by ten centimetres in diameter, resembling a testicle in shape, one portion representing the body of the testicle, covered by a dense, smooth, fibrous capsule, in which were many vessels. On one side corresponding to the epididymis was an opaque, grayish-white lobulated growth. On section, the centre of the tumor consisted of soft, hæmorrhagic, necrotic tissue, while the periphery was slightly denser, homogeneous, and gray in color. The mass had a thin elongated attachment which might be likened to a cord, but which contained nothing corresponding to the vas deferens. Microscopic examination showed growth to be composed of large round cells, many of which were multinuclear, with a little granular intercellular substance. No normal testicular tissue found. Round-celled sarcoma.

CASE 36.—At autopsy the left testicle was normal and the vas led normally to the seminal vesicle. The right testicle was not present, but in the right iliac fossa extending to the median line was a tumor mass covered by peritoncum and resting on the

PLATE IV.



1.



FIG. 1.—Sarcoma of the testicle from Case 23. The cord may be seen at the upper portion of the specimen

FIG. 2.—Photograph of Case 30. Taken four years after double orchidopexy. Shows unusually good result.

muscles which it infiltrated in places. The growth had pushed up between the folds of mesentery and displaced the ureter. It had also infiltrated the wall of the ileum for twelve centimetres above the ileoæcal valve, and was only separated from the lumen of the gut by a thin layer of mucous membrane. From this growth the vas led to a normal seminal vesicle. On section the tumor was extremely soft and extensively necrotic. Around the periphery it was grayish and homogeneous.

Microscopic examination showed masses of large round cells of varying size, separated by considerable intercellular substance, in which were spaces for the passage of blood without distinct walls. Here and there were bundles of smooth muscular fibres probably associated with some of the vascular trunks. The growth was roughly divided into lobules by dense bands of fibrous tissue. In no section was there any normal structure of the testicle. The vas was surrounded by tumor growth. Many of the cells showed mitotic figures. There were metastatic nodules in the portal vein and in a section of the liver. Round-celled sarcoma.

CASE 64.—Body of testicle was transformed into a tumor mass, nine centimetres in diameter, which on section was soft and opaque, and with a marked tendency to hæmorrhagic necrosis. Along the edge was a narrow zone of firmer grayish tissue, and in the connective tissue was a similar growth, in the midst of which were bright yellow necrotic areas.

Microscopic examination showed large round cells, separated by fibrillar intercellular substance, uniting with connective tissue. There was such extensive necrosis that only in a few areas could a cellular condition be made out. No normal structure of the testicle was found. No tumor growth detected at upper end of the cord. Large round-celled sarcoma.

TREATMENT.—The treatment of undescended testicle varies according to the age of the patient, the presence or absence of complications, and the severity of symptoms in a given case. A consideration of the age of the patient is of the utmost importance, for the treatment is essentially different in infancy, youth, and adult life.

*Uncomplicated Cases without Symptoms.*—As has been



shown, it is not unusual for infants at birth, and for some time thereafter, to have partially descended testicles on one or both sides. This condition is of no special importance, for the chances are very great that the organ will descend to the scrotum during the first few months. The failure of descent in no way affects the health, vitality, or development of the infant at this age, and no treatment with a view to correcting the deformity is of avail. The condition should be noted, nothing more.

During childhood the failure of descent of the testicle assumes greater importance, for the longer the condition persists, the smaller becomes the chance of its descending spontaneously. Nevertheless, until a late period in childhood is reached, the condition is of no greater importance than in infancy, except for the above reason. Children with one or even both testicles imperfectly descended, up to the age of ten or eleven years, show no abnormality referable to the defect. If, however, a child reaches the age of eleven or twelve, and the undescended organ still shows no tendency to progress to the scrotum, the condition should be regarded in a different light. The chance of its descending after this age is very small; also the age of puberty is approaching, at which time the testicle is to assume new functions, unless prevented from so doing by a faulty position. The period of childhood from eleven or twelve years to puberty is of great importance, for it is during this period that operations for transplanting the testicle to the scrotum are most frequently attended with good results, both as regards the ultimate location of the organ and its integrity.

In many of these cases the testicle by manipulation can be withdrawn from the canal and placed in the scrotum. If this is possible, gentle massage and traction should be tried daily, and in some cases such measures have apparently aided the testicle in its descent.

If a testicle is allowed to remain in an abnormal position during the period of puberty, there is good reason to believe that it will not undergo the changes incident to puberty, and

will probably remain functionless. It is rare for a surgeon to be called to treat an adult with undescended testicle with which there are no complications or symptoms caused by the deformity. The condition is usually noted and advice sought by the parents during childhood.

*Uncomplicated Cases with Symptoms referable to the Testicle.*—It is unusual for children under ten years of age to suffer from attacks of pain in the region of the misplaced organ unless there is a history of direct trauma. The testicle is small, usually freely movable, and lacks much of the peculiar testicular sensitiveness of later life. Operative treatment is rarely called for at this age for the relief of symptoms, unless the attacks of pain and swelling are severe, and are liable to impair the function of the testicle. Towards puberty the organ becomes more sensitive and there is a greater liability to pain. In adult life, pain and inflammation are of commoner occurrence, and relief by surgical treatment is often sought. It becomes then a question of the choice of operative procedure, the results of which are discussed later.

*Cases with Complications.*—By far the commonest is some form of hernia. If this exists, operation is to be advised considerably earlier in life than in simple cases. (Tuffier.) Operation consists in locating the testicle and treating it according to the existing condition as in uncomplicated cases, and in performing a radical cure of hernia. The treatment in cases with which other complications than hernia are associated has been described.

No child with double undescended testicle should be allowed to reach the age of puberty without an effort being made by operation to bring the organs to their normal position, for if the deformity is disregarded the individual will probably be sterile throughout life. It has been claimed that double arrest of the testicle is liable to interfere with the normal development at puberty, but it seems as if this rarely, if ever, occurs. Such influence as the testicles exert at puberty on the bodily development is probably not modified by the position of the organs. Although the function of spermatogenesis may

not be established, yet that other physiological influence, claimed by many to be due to an internal secretion of the gland, is present.

If the deformity is single, although good surgery demands an attempt at its correction being made, the importance of such a procedure is lessened, for the individual can maintain all functions with a single properly descended testicle. In operations on children, both organs should not be placed in the abdominal cavity, for such testicles are invariably functionless; and in no case, single or double in children, should orchidectomy be done, unless the testicle is hopelessly degenerated. In adults, with double arrest, if an attempt at orchidopexy is unsuccessful, the organs may be returned to the abdominal cavity. Orchidectomy should be done only as a last resort, and castration is never justifiable. No treatment is to be advised for abdominal retention.

The operations may be divided into three groups: (1) Orchidectomy; (2) Orchidopexy; (3) Replacement in abdomen. The choice is in all cases governed by the age of the patient and the condition and position of the organ as found at operation. If there is marked atrophy, and the other testicle is unquestionably normal in every respect, orchidectomy is the operation of choice, especially if there is a complicating hernia, for the testicle is functionless, and the removal of the cord makes it easier to close the canal, and thus prevent a recurrence of the hernia. Orchidopexy is the operation of choice in children; and in adults attempts should be made in most cases to lower the position of the testicle before orchidectomy or other measures are resorted to.

**TECHNIQUE.**—The inguinal canal is opened, as in the Bassini operation for hernia, thus exposing the testicle and spermatic cord. The cord is dissected free, and considerable traction exerted on it without incurring any danger. If little or nothing is gained by this procedure the vas should be dissected free. It is usually found to be very tortuous, and may extend in a loop below the testicle itself. The shortness of the cord is seldom due to the vas, but rather to the blood-vessels

which accompany it. Some operators advise a division of all but the vas, which allows the testicle to be brought to the scrotum with ease; in these cases the artery of the vas probably supplies the testicle through its anastomoses. This seems to be an unwarrantably radical proceeding, and while it has undoubtedly been successful in some cases, yet it is a well-known fact that in operations for varicocele, when only a part of the vessels are divided, gangrene of the testicle may supervene. The experiments on the blood-vessels, cited above, are of interest in this connection. If, as is rarely the case, the vas is that portion of the cord which prevents its being lengthened, the epididymis may be partially dissected free from the testicle, and the organ inverted.

If there has been a failure of closure of the processus vaginalis, and a congenital sac exists, the sac should be divided, its upper portion being disposed of by suture of the neck and excision, while its lower portion can be folded and stitched around the testicle, making a tunica vaginalis. The canal is closed as in the Bassini operation, the cord being fixed at the external ring by a stitch which fastens it to the aponeurosis of the external oblique. This stitch should be placed while traction is maintained on the cord. (Tuffier.<sup>85</sup>)

As the side of the scrotum corresponding to the undescended testicle has never been distended, it should be filled out with a mass of gauze early in the operation, which puts it on the stretch and forms a cavity for the reception of the testicle.

The testicle is held in the scrotum by suture of the tunica albuginea to the subcutaneous tissue of the scrotum, or it may be allowed to lie in its position without suture, held in place by a suitable bandage. Even when the greatest care is taken to anchor the organ at the base of the scrotum, there is almost invariably a marked tendency to retraction upward. The scrotum, especially if undeveloped, exerts little influence in holding the testicle down. This retraction may be apparent soon after the operation, or may be slow in making its appearance, the testicle gradually working its way upward for months after its transplantation.

An operation has been described by Katzenstein<sup>86</sup> in which the testicle is withdrawn from an opening in the base of the atrophied scrotum and sutured to the inner side of a pedunculated flap of skin dissected up from the inner side of the thigh. This flap is later cut off and made to form a new base to the scrotum.

When, in adults, orchidopexy is found to be impossible, and it is deemed best not to remove the testicle, it may be replaced in the abdominal cavity, and the canal closed tight by suture. This procedure renders the organ functionless, and is liable to be followed by a recurrence of the trouble, for the testicle may find its way again, after the lapse of some time, into the inguinal canal. (Case 20.)

RESULTS OF OPERATION.—In considering the value of the operation as to end results, attention should be paid to the ultimate position of the testicle, its size, and probable functioning powers, and the relief or aggravation of symptoms. No attempt has been made to tabulate the end results in cases treated by orchidectomy.

*Orchidopexy.*—If the aim of the surgeon is merely to draw down the testicle sufficiently to fix it outside the external ring, his effort is almost invariably attended with success. Most testicles, lying in the canal, can be brought down by traction or otherwise into such a position. This allows a tight closure of the canal, and thus prevents the likelihood of a recurrence of a complicating hernia. Many believe that the testicle should be spared even if much atrophied, on account of its supposed value in the economy. On the other hand, many operators are not satisfied with such a result, believing that an organ so placed is in a position likely to cause much discomfort, and, being undoubtedly functionless, is much better removed.

Brocha<sup>87</sup> operated on 138 cases. Seventy-nine were followed for one year; thirty-one of these were normal in size and position; thirty-five were normal in size, but situated high in the scrotum; thirteen were atrophied. All of these cases, however, were in young children; and Keyes,<sup>88</sup> commenting on the series, says that no such results could have been obtained in adults.

Coley operated on thirty-eight patients, of whom twenty-seven were children, and all were under thirty years of age. In only two of these cases did he find it best to remove the testicle.

Tuffier<sup>30</sup> reported a series of twenty-five cases in which orchidopexy was done in twenty-three. The end result is not known.

The literature abounds in reports of single cases in which orchidopexy was satisfactorily performed; but the end result of such cases is difficult to ascertain.

In the following table, there were twenty-four orchidopexies done on twenty-two patients, two having double retention. The end result in eighteen of these cases is known. Seven of these were under fourteen years of age.

#### DETAILED RESULTS OF ORCHIDOPEXIES.

CASE 11.—1893. Aged twenty years. Right testicle at internal ring; inguinal hernia; pain for several years. Sutured into scrotum, the cremaster being divided and globus minor dissected off testicle. Bassini for hernia. Eleven years later, organ much atrophied in extreme upper part of scrotum. Until two years ago had much pain. No recurrence of hernia.

CASE 16.—1894. Aged five years. Right inguinal retention. Symptoms for three weeks following trauma. Sutured in serotum with fine silk. Inguinal hernia, not congenital; Bassini operation. Ten years later, testicle vaguely felt in canal, very much atrophied. Serotum atrophied. No symptoms; no recurrence of hernia.

CASE 24.—1897. Aged forty-two years. Left inguinal retention; right inguinal hernia; pain on left side after exertion. Testicle sutured in scrotum; Bassini on right. Six and one-half years later, left testicle situated one and one-half inches below external ring, in scrotum. Very much atrophied, about one-sixth normal size. No symptoms.

CASE 30.—(See Plate IV, Fig. 2.) 1899. Aged thirteen years. Left testicle felt over external ring, normal in size. Right testicle not felt (abdominal). Serotum atrophied. No symptoms. Left testicle freed and sutured in scrotum. One year

later, left testicle in scrotum. Right testicle felt under skin above external ring. Dull pain in right groin for six months. Right testicle found subcutaneous, easily sutured into scrotum. Open processus vaginalis, closed; Bassini.

Four years after second operation, left testicle normal in size and position, freely movable; congenital hydrocele present. Right testicle normal in size and position, freely movable. Scrotum and penis well developed. No symptoms.

CASE 32.—1899. Aged eleven years. Left inguinal retention with inguinal hernia. No symptoms. Testicle sutured in scrotum. Bassini.

Four years later, testicle much atrophied, immovable at external ring, very tender, and frequently inflamed. Scrotum atrophied. No recurrence of hernia.

CASE 37.—1900. Aged twenty-six years. Double inguinal retention and double inguinal hernia. Pain, most noticeable on right side. Both testicles found small and atrophied, but sutured into scrotum with difficulty, owing to shortness of the cords; Bassini. Three weeks later both testicles retracted into the external rings. Three and one-half years later both testicles felt in canals, very small. Scrotum atrophied. No recurrence of hernia. Patient strong and athletic; has normal intercourse. Unmarried.

CASE 49.—1901. Aged sixteen years. Right inguinal retention. Pain for a few months. Testicle sutured into scrotum. Two and one-half years later testicle about one-fifth normal size, very high in scrotum. No symptoms.

CASE 50.—1901. Aged twenty-one years. Left inguinal retention with inguinal hernia. Attacks of pain and swelling for ten years. Testicle sutured to base of scrotum, the spermatic vessels being divided; Bassini. Two and one-half years later testicle about one-half normal size in upper part of scrotum. No symptoms; no recurrence of hernia.

CASE 55.—1901. Aged twenty years. Left inguinal retention. Painful swelling for three months. Testicle sutured in scrotum without difficulty. At end of operation it was one and one-half inches below external ring. Two years later testicle one-half normal size, situated slightly higher than right, in fair position. Organ causes much pain, due to frequent injury.

CASE 60.—1902. Aged twenty-four years. Left inguinal retention with congenital hernia. No symptoms. At operation

testicle appeared normal, sutured in scrotum; Bassini. Thirteen months later testicle retracted to pubes. Has some pain. No return of hernia.

CASE 62.—1902. Aged nineteen years. Right testicle at external ring. Inguinal hernia. Attacks of pain for two years. Testicle found normal in size, in congenital sac. Cord short. Sutured with difficulty in serotum. Three weeks later, retracted to level of root of penis. Thirteen months later, testicle in canal, much atrophied, causing pain most of the time. Scrotum on right entirely atrophied. No return of hernia.

CASE 63.—1903. Aged thirteen years. Left inguinal retention with congenital hernia. No symptoms. Sutured in scrotum; Bassini. One year later, testicle situated high in scrotum; no symptoms; no return of hernia.

CASE 66.—1903. Aged twenty-eight years. Right inguinal retention and congenital hydrocele. Pain in groin. Testicle sutured in scrotum; Bassini. Nine months later, testicle one-fifth normal size, just outside external ring. Pain continues. Scrotum atrophied. No return of hernia. Sexual neurasthenic.

CASE 68.—1903. Aged thirteen years. Right inguinal retention with congenital hydrocele sac. Attacks of severe pain for two years. Sutured into scrotum. Three weeks later was one inch below ring. Nine months later testicle in extreme upper part of scrotum. Slight pain at times.

CASE 69.—1903. Aged five years. Right inguinal retention with inguinal hernia. Considerable pain at times. Sutured in scrotum; Bassini. Nine months later, testicle just outside ring; no return of hernia; no pain.

CASE 75.—1903. Aged twenty-two years. Double inguinal retention with strangulated hernia on left side. Symptoms due to hernia. Bowel returned to abdomen; Bassini. Left testicle very small, held just outside ring by close suture of external oblique aponeurosis. Three weeks later, testicle in same position; no symptoms.

SUMMARY.—Orchidopexy was performed seven times in children ranging in age from five to thirteen years. In but two instances was a perfect result obtained, and this in the same patient, aged thirteen, who had double retention. Both testicles are normal in size, position, and probably in function-



ating power. Two other boys were operated on at the same age, thirteen; and in both the testicles have remained in the scrotum. Although they have retracted to a position high in the scrotum, they are not in contact with the pubic bone. Neither testicle is notably atrophied. One of the patients suffers some pain. One case, aged eleven, has a poor result, the testicle being much atrophied and fixed firmly just outside the ring, where it is a constant source of pain, and would better be removed. Two children were five years old at operation. In one the testicle drew up into the canal, where it remains, very small and undeveloped; in the other, it retracted to the pubic region, where it has, as yet, given no trouble. The only really satisfactory results were in the four cases aged thirteen.

As a result of the eleven operations performed in adults from sixteen to forty-two years of age, five testicles have remained in the scrotum, four of them occupying a high position in it, while the remaining one is in almost perfect position, and fully one-half normal size, yet is the seat of frequent inflammatory attacks due to injury. Three testicles retracted soon after operation into the canals, where they remain, very much atrophied. One of them is the cause of much pain. Two have retracted to the pubic region, where they are the source of considerable annoyance, undoubtedly due to their position. One of these is atrophied.

In every case in which the organ appeared normal at the time of operation, there has been a subsequent diminution in size: in two cases, however, the atrophy is not very marked, the testicle being fully one-half normal size.

In two cases symptoms were distinctly relieved, in three not relieved, and in two others were aggravated.

In no case has there been a recurrence of a complicating hernia.

#### RESULTS OF CASES IN WHICH TESTICLE WAS REPLACED IN THE ABDOMINAL CAVITY.

CASE 20.—1895. Aged fourteen years. Double inguinal retention. Painful tumor in each groin. At operation, left testicle was placed in abdomen, as cord was very short.

Examination eight years later. Left testicle vaguely felt in canal. Right testicle, very small, situated at external ring. Wears truss, as much pain results if testicles are allowed to emerge from the rings. Patient is married and has one child.

CASE 39.—1900. Aged nine years. Left inguinal retention with congenital hernial sac. Pain for a year following trauma. Testicle placed in abdomen. Three and one-half years later, left side of scrotum atrophied. No symptoms; no return of hernia. Testicle not felt. Testicular sense on deep pressure in left iliac region.

CASE 43.—1900. Aged twenty-one years. Left inguinal retention with congenital hernial sac. No symptoms. Small atrophied testicle placed in abdomen. Three and one-half years later, no symptoms, no return of hernia. Testicle not felt; had not re-entered canal.

CASE 45.—1900. Aged twenty-five years. Right inguinal retention with incarcerated congenital hernia. No symptoms referable to testicle. Operation for hernia; testicle returned to abdomen. Three years later, no symptoms. Testicle could not be felt; no recurrence of hernia.

CASE 74.—1903. Aged twenty years. Double inguinal retention. Pain for two years. Both testicles returned to abdomen. Six months later, no symptoms; neither testicle to be felt.

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TABLE OF CASES.

No.	Age.	Date.	Side.	Position.	Operation.	Complications.	Service of	Remarks.
1	30	1877	R.	Pubic.	o	o	G. G. Tarbell.	Death; meningitis. Plate III, Fig. 1.
2	46	1879	L.	Abdominal.	o	Sarcoma.	C. B. Porter.	Death in one year.
3	14	1886	R.	Pubic.	o	Inguinal hernia.	M. H. Richardson.	Left testicle descended at five years of age.
4	21	1887	R.	Pubic.	Relieved by manipulation.	o	A. T. Cabot.	.....
5	30	1888	R.	Pubic.	For strangulated hernia.	Strangulated inguinal hernia.	H. H. A. Beach.	Died in hospital.
6	22	1888	R.	Inguinal.	Orchidectomy.	Tuberculosis of testicle.	M. H. Richardson.	Pathological Report. (William F. Whitney.)
7	48	1889	Double.	R. pubic. L. subcutaneous.	R. orchidectomy. L. orchidectomy.	Double inguinal hernia.	J. Homans.	.....
8	30	1890	R.	Pubic.	Orchidectomy.	Inguinal hernia.	A. T. Cabot.	.....
9	20	1892	R.	Inguinal.	o	Inguinal hernia.	A. T. Cabot.	Hernia reduced; ether. Died, 1895.
10	26	1892	R.	Pubic.	Orchidectomy.	Inguinal hernia.	A. T. Cabot.	.....
11	20	1893	R.	Inguinal.	Orchidectomy.	Inguinal hernia.	J. Homans.	Examined December, 1903.
12	23	1894	R.	Pubic.	o	Strangulated congenital hernia.	J. C. Warren.	Operation for hernia. Death.
13	18	1894	L.	Puboscrotal.	o	Inguinal hernia.	J. C. Warren.	Operation for hernia.
14	23	1894	L.	Pubic.	o	Inguinal hernia.	J. C. Warren.	Operation for hernia reported December, 1903.
15	37	1894	Double.	R. abdominal. L. inguinal.	R. o L. o	o	H. H. A. Beach.	Right testicle seen at appendectomy. Died six months later.
16	5	1894	R.	Abdominal.	Orchidectomy.	Inguinal hernia.	S. J. Mixer.	Examined December 1903.
17	33	1894	R.	Inguinal.	o	Inguinal hernia.	H. H. A. Beach.	.....
18	20	1895	R.	Inguinal.	o	Strangulated inguinal hernia.	H. H. A. Beach.	Hernia reduced; ether. Examined December, 1903.
19	46	1895	Double.	R. inguinal. L. inguinal.	R. o L. o	R. sarcoma. L. sarcoma.	F. C. Shattuck.	Death in hospital; autopsy.

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20	14	1895	Double.	R. inguinal. L. inguinal.	R. put in abdomen. Put in abdomen.	o	o	Parotitis. 1903.	Examined December, 1903.
21	24	1895	R.	Inguinal.	R. o	o	o	S. J. Mixer.	
22	14	1896	Double.	R. pubic. L. puboscrotal.	R. o	o	o	A. T. Cabot.	
23	27	1896	Double.	R. abdominal. L. inguinal.	R. o	o	o	J. W. Elliot.	
					L. orchidectomy.				
24	42	1897	L.	Pubic.	Orchidectomy.			F. B. Harrington.	Operation for hernia on right. Ex- amined December, 1903.
25	21	1898	L.	Abdominal.	o			J. Homans.	Operation for hernia. Examined December, 1903.
26	49	1898	R.	Inguinal.	Orchidectomy.			C. B. Porter.	Death, January, 1902. Recur- rence. Specimen.
27	10	1898	Double.	R. abdominal. L. inguinal.	R. o L. orchidectomy.	o	o	S. J. Mixer.	
					Orchidectomy.				
28	28	1898	L.	Abdominal.	Orchidectomy.			J. Homans.	Death in one year. Recurrence. Plate IV, Fig. 1.
29	19	1899	L.	Puboscrotal.	Orchidectomy.			C. B. Porter.	
30	13	1899	Double.	R. abdominal. L. inguinal.	R. orchidectomy. L. orchidectomy.	o	o	J. Homans. A. T. Cabot.	Left operated, 1899; right, one year later. Plate IV, Fig. 2.
31	19	1899	R.	Pubic.	Orchidectomy.			J. W. Elliot.	
32	11	1899	R.	Inguinal.	Orchidectomy.			C. B. Porter.	Examined December, 1903.
33	21	1899	R.	Inguinal.	Orchidectomy.			C. B. Porter.	Pathological Report. (William F. Whitney.)
34	23	1899	R.	Abdominal.	Orchidectomy.			H. H. A. Beach.	
35	19	1899	R.	Pubic.	Orchidectomy.			C. B. Porter.	Died, 1902. Tuberculosis.
36	46	1900	R.	Abdominal.	Orchidectomy.			Private case. H. Jackson.	Died two months later. Recur- rence. Autopsy.
37	26	1900	Double.	R. inguinal. L. inguinal.	R. orchidectomy. L. orchidectomy.			M. H. Richardson.	Examined December, 1903.

TABLE OF CASES.—Continued.

No. Age.	Date.	Side.	Position.	Operation.	Complications.	Service of	Remarks.
38 27	1900	L.	Inguinal.	Orchidectomy.	Congenital inguinal hernia.	A. T. Cabot.	.....
39 9	1900	L.	Abdominal.	Put in abdomen.	Congenital inguinal hernia.	F. B. Harrington.	Examined December, 1903.
40 11	1900	Double.	R. inguinal. L. puboscrotal.	R. orchidectomy. L. o	R. inguinal hernia. o	A. T. Cabot.	.....
41 5	1900	Double.	R. inguinal. L. inguinal.	R. o L. o	R. inguinal hernia. o	M. H. Richardson.	.....
42 11	1900	R.	Abdominal.	Put in abdomen.	R. Congenital ingui- nal hernia.	M. H. Richardson.	Operation for acute appendicitis.
43 21	1900	R.	Inguinal.		L. inguinal hernia.	F. B. Harrington.	Operation for hernia. Reported December, 1903.
44 16	1900	L.	Inguinal.	Orchidectomy.	Inguinal hernia.	C. B. Porter.	Specimen.
45 25	1900	R.	Inguinal.	Put in abdomen.	Strangulated congen- ital hernia.	H. H. A. Beach.	Reported December, 1903.
46 10	1900	R.	Inguinal.	o	Inguinal hernia.	H. H. A. Beach.	Examined December, 1903.
47 16	1900	L.	Abdominal.	Orchidectomy.	o	I. C. Warren.	Specimen. Plate I, Fig. 1.
48 32	1901	R.	Inguinal.	Orchidectomy.	Strangulated inguinal hernia.	J. W. Elliot.	.....
49 16	1901	R.	Inguinal.	Orchidopexy.	o	J. W. Elliot.	Examined December, 1903.
50 21	1901	L.	Pubic	Orchidopexy.	Inguinal hernia.	J. W. Elliot.	Examined December, 1903.
51 16	1901	R.	Inguinal.	Orchidectomy.	Inguinal hernia.	W. M. Conant.	Specimen.
52 20	1901	L.	Inguinal.	Orchidectomy.	Gonorrheal epididy- mitis.	S. J. Mixer.	Pathological report. (J. H. Wright.)
53 11	1901	L.	Inguinal.	Orchidectomy.	Congenital inguinal hernia.	S. J. Mixer.	.....
54 37	1901	R.	Pubic	Orchidopexy.	Strangulated inguinal hernia.	S. J. Mixer.	.....
55 20	1901	L.	Inguinal.	Orchidopexy.	Congenital hydrocele.	C. B. Porter.	Examined December, 1903.
56 12	1901	L.	Pubic	Orchidectomy.	Strangulated congen- ital interstitial her- nia.	J. C. Warren.	.....



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FIG. 1.—Hypernephroma. Showing the external appearance of the kidney and tumor about one-third smaller than at the time of operation.